# NBP and $CO_2$ Calibration Instructions

M3535A/M3536A HeartStart MRx

PHILIPS

# Notice

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Contains FCC ID: PQC-WMTS-MODULE

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# Conventions Used in This Manual

These upgrade instructions contain the following conventions:

**WARNING** Warning statements describe conditions or actions that can result in personal injury or loss of life.

**CAUTION** Caution statements describe conditions or actions that can result in damage to the equipment or loss of data.

**NOTE** Notes contain additional information on usage.

**TIP** Tips provide hands-on insight into servicing this product.

**Text** represents messages that appear on the display

**[Softkey]** represents softkey labels that appear on the display above or below the button to which they correspond.

## On-line viewing only

Hypertext represents hypertext links, which will display as blue; click on the blue link to go to that destination, then click on the blue destination to return.

## Abbreviations

| Name | Abbreviation |
|---|---|
| HeartStart MRx Monitor/Defibrillator | monitor/defibrillator device |
| Carbon dioxide | $CO_2$ |
| End-tidal carbon dioxide | $EtCO_2$ |
| Non-invasive Blood Pressure | NBP |

# Introduction

**CAUTION** These instructions are intended for users trained in the safe and proper HeartStart MRx operation.

HeartStart MRx NBP and $EtCO_2$ calibration is part of the HeartStart MRx maintenance routine that also includes operational checks, lithium ion battery maintenance, etc. described in HeartStart MRx *Instructions for Use.* NBP and $EtCO_2$ calibration is the only HeartStart MRx maintenance procedure not covered in the *Instructions for Use.*

This document covers the following calibration procedures:

- Yearly calibration (or every 10,000 cycles, whichever is sooner) of the Non-invasive Blood Pressure (NBP) module
- Yearly calibration (or every 4000 hours, whichever is sooner) of the End-tidal Carbon Dioxide ($EtCO_2$) module.

Use these quick links to access the calibration procedures:

☝ NBP Module Calibration

☝ $EtCO_2$ Module Calibration

## HeartStart MRx Calibration Overview

Consider reviewing the "HeartStart MRx Calibration" instructional video included in your calibration kit before proceeding with the calibration. To watch the DVD on your PC, you may need to install the latest version of Windows Media Player® available for free download from Windows Media download center http://www.microsoft.com/windows/windowsmedia/download/.

The video is also available online at http://theonlinelearningcenter.com/schtml/mrx/calibration/.

Perform calibration when prompted by the **CO2 Calibration Overdue** and **NBP Calibration Overdue** inops. If a calibration is overdue, then the HeartStart MRx Op. Check fails with the code Fail/D (Versions B.05 and above) or Fail/NC (Versions prior to B.05).

Regardless of your configuration settings, millimeters of mercury are the unit of measure for pressure in the HeartStart MRx calibration. Use the conversion formulae from Table 1 if necessary:

**Table 1 Units of Pressure Conversion**

| 1 unit | = | __ mmHg |
|---|---|---|
| 1 kPa | = | 7.5 mmHg |
| 1 mb | = | .75 mmHg |
| 1 psi | = | 51.7 mmHg |
| 1 atm. | = | 760 mmHg |
| 1 inHg | = | 25.4 mmHg |

**Example:**

30 inHg = 30 × 25.4 mmHg = 762 mmHg

### Accessing Service Mode

The calibration activities are accessed through the Service Mode. To access the Service Mode:

1 From the Main Menu select **Other,** then **Service.**

2 Enter the "27689" password when prompted by the device.

# NBP Module Calibration

This section describes how to calibrate the HeartStart MRx NBP module.

To calibrate the HeartStart MRx NBP module you need:

- the manometer and cuff assembly
- the plastic container to wrap the cuff around

Both the manometer / cuff assembly and plastic container are provided in the "NBP Calibration Kit," part # 453564063841.

## NBP Calibration Setup

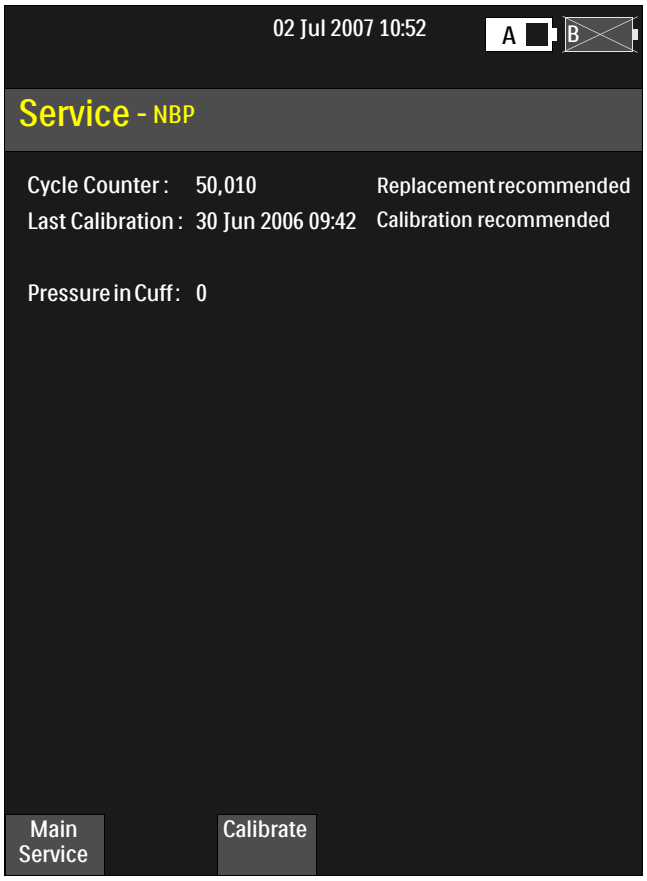
To prepare for NBP calibration:

1 Access the Service Mode Main menu as described in "Accessing Service Mode" on page 1.

2 From the Service Mode Main menu, select **NBP**.

The NBP Service screen is displayed (see Figure 1). You may hear a soft, high-pitch tone, this is normal NBP pump operation.

**Figure 1 NBP Service Screen**



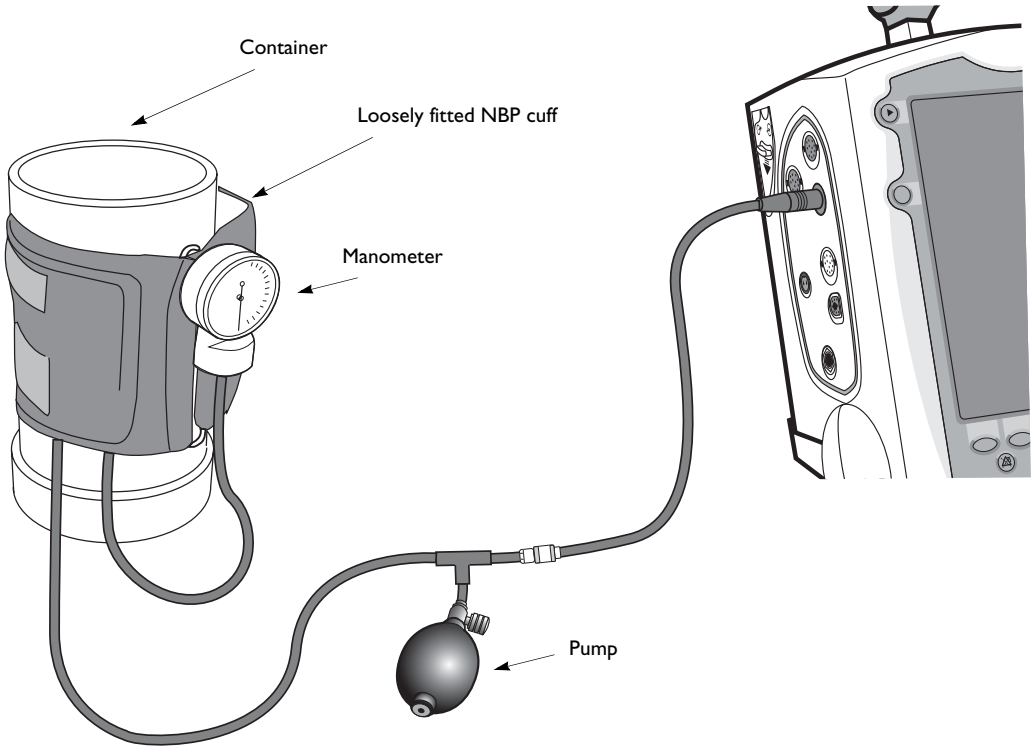

3 Check the Cycle Counter.

If the NBP module has executed more than 50,000 cycles, replacement is recommended. **Do not proceed with the calibration. Call for service.**

4 Connect the test cuff assembly to the NBP port and wrap the cuff around the container (see Figure 2).

Do not overtighten the cuff. It should have space for about 500 mL of air. Leave room for two fingers between the cuff and container before connecting the velcro.

**Figure 2 NBP Calibration Setup**




# NBP Safety Features

The NBP module is equipped with the Timeout and Overpressure safety features that prevent injury to the patient and damage to the device.

## NBP Timeout

The NBP module times out when the pressure remains greater than 10 mmHg for 3 minutes. Do not keep the cuff pressurized for more than 3 minutes during the calibration.

## NBP Overpressure

The NBP module overpressure occurs when the cuff pressure reaches 300 mmHg. Do not raise the pressure in the cuff to more than 280 mmHg during the calibration.

The safety features cause the valve to open and the pressure to drop. If a safety feature is triggered during calibration, then reset the module:

1 Press the **[Main Service]** softkey

2 Access the NBP Service screen to restart the calibration.

# NBP Calibration Procedure

Complete the calibration process within three minutes to avoid the NBP module timeout.

To calibrate:

1 Press the **[Calibrate]** softkey.
The message **Apply 0 mmHg. Select Next when ready** is displayed.

2 Release all of the pressure in the cuff so that the manometer reads 0 mmHg.

3 Press the **[Next]** softkey.
The message **Apply 250 mmHg. Select Next when ready** is displayed.

4 Increase the pressure so that the manometer reads 250 mmHg.
Take time to allow the pressure in the unit to equalize and stabilize. One way to do this is to pressurize the cuff to 255 or 260 mmHg and wait for 30 seconds, then gently adjust the pressure with the pump and valve.

5 When the pressure is stable at 250 mmHg, press the **[Next]** softkey again.

6 Wait until the message **Calibration complete. Please perform the accuracy and leakage tests to check the results** is displayed.

NOTE The message instructing you to perform the accuracy and leakage tests is for field service engineers only. These tests do not need to be performed as part of calibration.
After several seconds the message clears, and the NBP Service screen is displayed.

7 Release the pressure in the cuff to avoid the safety timeout.

8 Run an operational check to update the calibration status.
See *HeartStart MRx Instructions for Use* for op.check guidance.

## NBP Calibration Failure

If the error message **Calibration failed. Check that the pressure applied is correct. Please restart calibration** appears at any moment during NBP calibration, then:

1 Recheck the manometer and cuff assembly connections.

2 Loosen the cuff. If less than ten pump compressions fill the cuff, then it is too tight.

3 Press the **[Main Service]** softkey.

4 Select **NBP** from the Service Main Menu.

5 Restart the NBP Calibration Procedure, making sure that the applied pressures are correct.

6 Call for service if you cannot successfully complete the calibration

# EtCO2 Module Calibration

This section describes how to calibrate the HeartStart MRx EtCO2 (here called CO2) module.

To calibrate the HeartStart MRx CO2 module you need:

- Gas flow valve
- Modified Filterline set with T-shaped tubing assembly
- 5% calibration gas cylinder (15210-64010)
- A calculator
- A barometer to measure ambient pressure or other means of determining the ambient pressure.

Both the gas flow valve and Modified Filterline are provided in the "CO2 Calibration Kit," part # 453564063851. The CO2 Calibration Kit also contains a flow tube and two air plugs that are used for troubleshooting only and not used in calibration.

## CO2 Calibration Setup

Before performing calibration, the CO2 sensor must warm up for at least 20 minutes. Do not start calibration until the CO2 sensor has been warmed up.

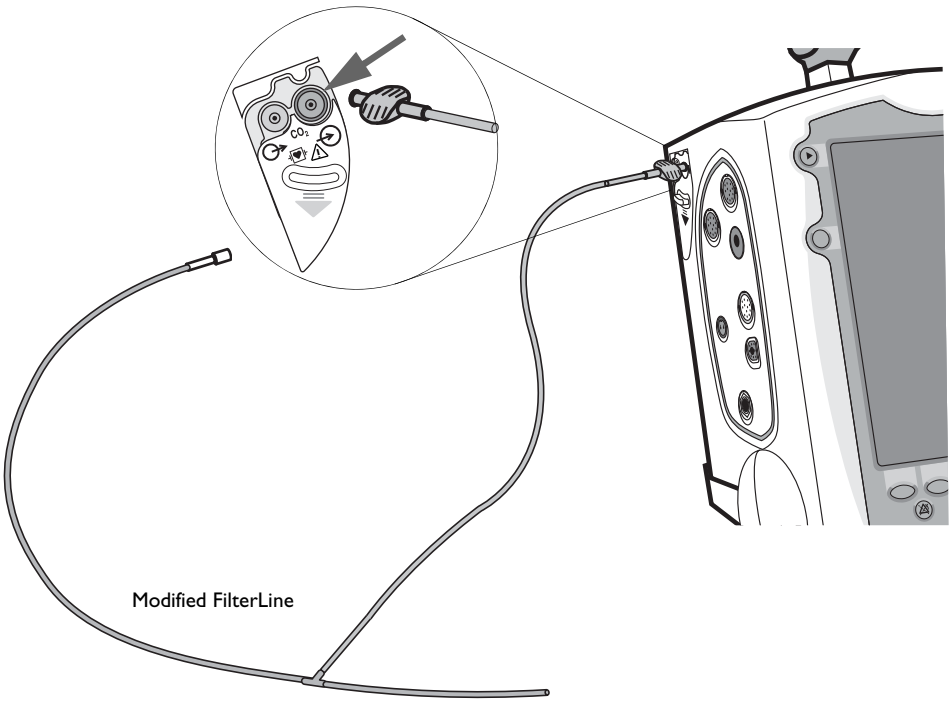
### Warm Up the CO2 Sensor

To warm up the CO2 sensor:

1 Access the Service Mode Main menu as described in "Accessing Service Mode" on page 1.

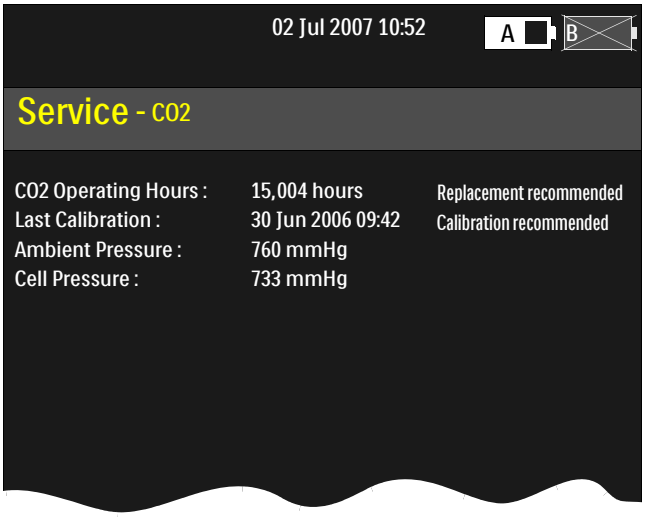
2 Connect the Modified FilterLine from the kit to the HeartStart MRx CO2 inlet marked . See Figure 3.

**Figure 3 CO2 Warm-Up Setup**



3 From the Service Mode Main menu, select **CO$_2$.**
After a few seconds delay, the CO$_2$ Service screen is displayed, as shown in Figure 4.

**Figure 4 CO$_2$ Service Screen**




You may hear a soft, low-pitch tone, this is normal CO$_2$ pump operation. Another indication of the CO$_2$ pump activity is the difference between the Ambient and Cell pressures. Subtract the Cell pressure from the Ambient pressure and consult Table 2 to interpret the difference.

**Table 2 Modified FilterLine Connection Checking and Troubleshooting**

| Ambient Pressure – Cell Pressure | Possible Cause | Suggested Solution |
|---|---|---|
| 0 | Bad connection | 1 Reconnect the Modified FilterLine.<br>2 Go back to Main Service and reselect CO2. |
| | Pump malfunction | Call for service. |
| 9 mmHg or less | Modified FilterLine is broken | Replace the Modified FilterLine. |
| | Pump malfunction | Call for service. |
| 10 - 30 mmHg | The pump is operating normally, and the sensor is warming up. | |
| 31 mmHg or more | Modified FilterLine is blocked | Check that the Modified FilterLine is not kinked and free of blockages. Replace if necessary. |

3 When the pump starts working as expected, clock the warm-up time. You can use the HeartStart MRx screen clock.

## Prepare for the Calibration

Perform the following preparatory steps while the $CO_2$ sensor is warming up:

1 Check the $CO_2$ Operating Hours.
If the $CO_2$ module has clocked more than 15,000 hours, replacement is recommended.
**Do not proceed with the calibration. Call for service.**

2 Obtain a reliable measurement of local atmospheric pressure by using a barometer or by getting the local atmospheric pressure data from the Internet, local airport, or weather station located at the same altitude as your lab.

3 Press the Menu Select button and select Ambient Pressure.

4 Using Up and Down buttons, adjust the HeartStart MRx's Ambient Pressure setting to the measurement obtained in Step 2.

5 Press the Menu Select button again to accept the adjusted Ambient Pressure value.

6 Calculate the expected $CO_2$ reading.
The expected $CO_2$ reading depends on both the gas concentration you are using (5.0%) and the ambient pressure. Calculate as follows:

a. `Cal. Gas Concentration x ambient pressure = Expected CO2 value`
For example:
`[0.05] x [760 mmHg] = 38 mmHg`

b. Calculate the allowable tolerance, which is ± 5% of the expected reading. Calculate as follows:
`[±0.05] x Expected CO2 value = ± tolerance (mmHg)`
For example:
`[±0.05] x 38 = ± 1.9 (mmHg)`
In this example, the displayed reading is expected to be 38 ± 1.9 mmHg.

c. Round to the nearest whole number because HeartStart MRx does not show fractions. The expected $CO_2$ reading in our case should be between 36 and 40 mmHg.

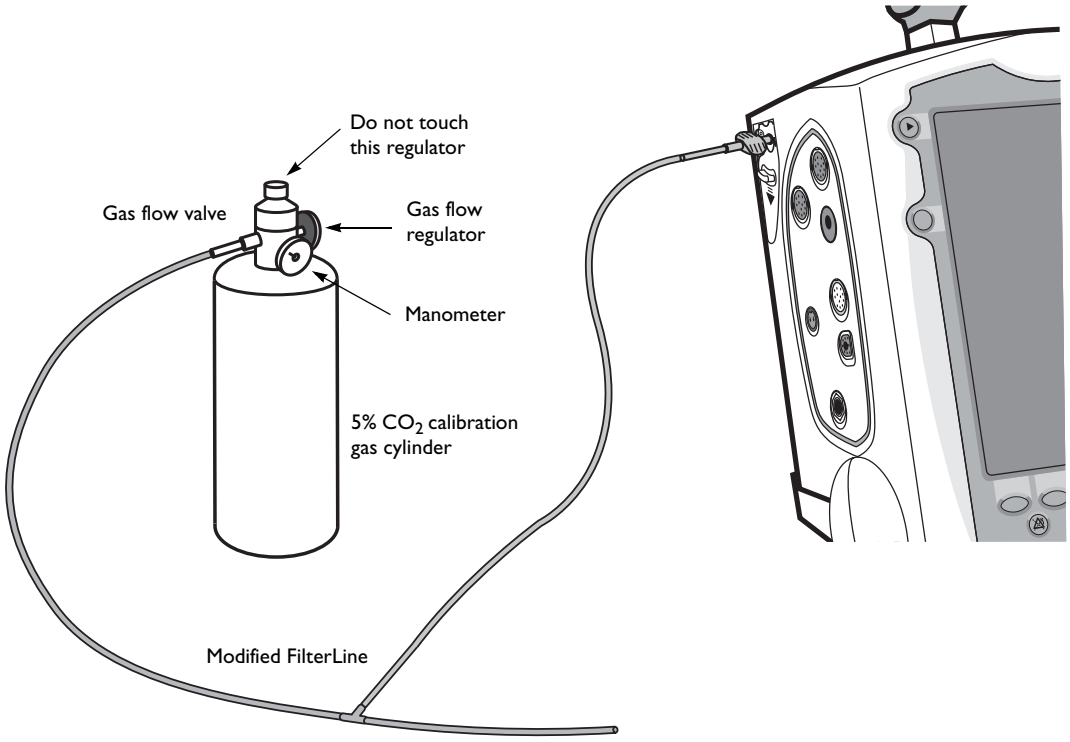
d. Save your calculations. You will compare the numbers with the actual $CO_2$ sensor reading during the calibration validation.

7 Fit the 5% $CO_2$ gas cylinder with the valve. Screw the valve on tightly.

8 Watch the manometer on the valve.
While the gas pressure does not have to be high for successful calibration, it should be present.

9 Connect the soft tubing at one end of the modified Filterline to the gas valve outlet, and leave the other end open to atmosphere. See Figure 5.

**Figure 5 $CO_2$ Calibration Setup**




## $CO_2$ Calibration Procedure

Make sure the $CO_2$ sensor has been warmed up for at least 20 minutes before starting the calibration steps.

To calibrate the $CO_2$ module:

1 From the $CO_2$ Service menu, select **Calibration Check.**
The $CO_2$ Calibration screen is displayed.

2 Wait a few seconds until the softkeys become active. See Figure 6.

**Figure 6 $CO_2$ Calibration Screen**

3 Fully open the gas flow valve.

Turn the regulator on the side of the valve counterclockwise. Do not touch the regulator on the top of the valve.

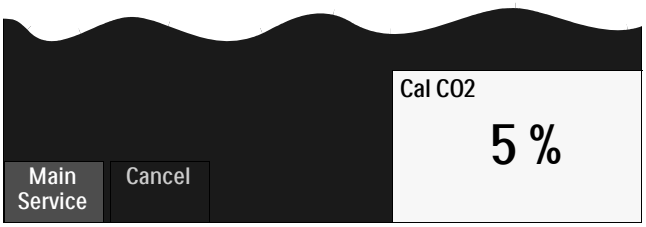
4 Allow the $CO_2$ value to stabilize.

5 Press the **[Calibrate]** softkey.

6 Use the Menu Select key to confirm that you are using the 5% $CO_2$ gas mix. See Figure 7.

While it is recommended that you use the 5% gas, you can calibrate $CO_2$ module with 4% or 6% $CO_2$ gas mix.

**Figure 7 $CO_2$ Cal Gas Selection**




7 Do not turn off gas or touch any buttons or tubing until completion.

The **CO2 calibration in progress** message indicates that the calibration has started.
The **Calibration complete** message indicates that the calibration is successful.

8 Turn off the gas.

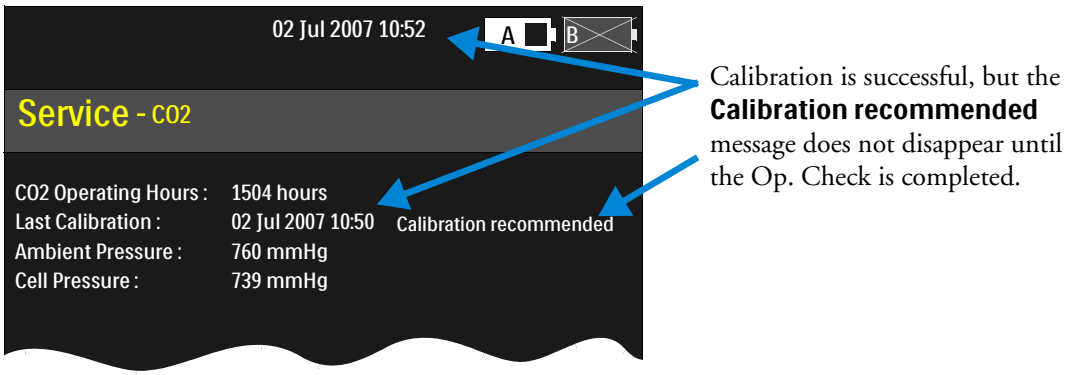
9 Validate the calibration by checking the displayed $CO_2$ value against the expected value calculated in the Prepare for the Calibration section.

The displayed value should match the expected value within the calculated allowable tolerance.

10 Press the **[Done]** softkey.

Note that even though the calibration is successful (the time of last calibration is updated), the calibration status does not get updated until the op. check is completed. See Figure 8.

**Figure 8 Successful $CO_2$ Calibration**


02 Jul 2007 10:52
A
B
Service - CO2
CO2 Operating Hours : 1504 hours
Last Calibration : 02 Jul 2007 10:50
Ambient Pressure : 760 mmHg
Cell Pressure : 739 mmHg
Calibration recommended
Calibration is successful, but the Calibration recommended message does not disappear until the Op. Check is completed.

11 Run an Operational Check to update the calibration status.

See *HeartStart MRx Instructions for Use* for Op. Check guidance.

## $CO_2$ Calibration Failure

If the error message **Calibration failed. Please restart calibration** appears at any moment during $CO_2$ calibration, then:

1. Recheck the Modified FilterLine, gas cylinder, and valve connections.
2. If the $CO_2$ module is off, restart the warm-up process and wait for 20 minutes.
   See the Warm Up the $CO_2$ Sensor section.
3. Restart the $CO_2$ Calibration Procedure.
4. If you cannot successfully complete the calibration, call for service.

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